METAL INDUSTRY

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Trade with Portugal

AN important opportunity for the British manufacturer to expand his sales in a traditional market is provided by the proposals recently published by the Portuguese Government for their second six-year development plan, for the period 1959 to 1964. These plans provide for the expenditure under Government auspices of the equivalent of £375 million during the next six years in Metropolitan Portugal and the Portuguese Overseas Provinces. During the same period the Government expect that gross investment in Portugal outside the plan, by the private concerns, will total £594 million. All this means a great increase in imports of capital goods. In recent years, Portugal's imports have been increasing steadily while British exports to that country have been expanding more slowly. The plan offers another opportunity to enlarge our hold on this market, and regain the position of Portugal's most important supplier which we lost to Germany a few years ago.

This new six-year plan covers the whole of the economic life of the country, and includes agriculture, shipping and shipyards, metallurgical and chemical industries, electricity generation and distribution, railways, ports and airports, and general engineering projects. A survey of the mineral resources of the country is to be carried out; an installation for the production of uranium metal from Portuguese ores is to be set up (a contract for a pilot installation has already been signed); the second phase of a steelworks project is to be carried out, and the enlargement of the existing oil refinery capacity is to be undertaken. Electricity production is to be raised and new generating stations constructed; main line railways to be brought up to date, electrification included, and renewal of signals and telecommunications, etc.; additional works at all ports of Continental Portugal, Madeira and the Azores are planned, and a new bridge is to be built over the river Tagus at Lisbon.

Portugal is a buyers' market. Stable and free from import restrictions, there are many countries who wish to sell there. The Commercial Department of the British Embassy in Lisbon points out, therefore, that the Portuguese can afford to pick and choose among suppliers and to lay down their own terms. It is no good offering them a product which is not exactly what they have asked for; nowadays they can find what they want elsewhere. It is no good setting out quotations with prices f.o.b., or weights and measures not in the metric system. There is no reason why the Portuguese buyer should bother to accommodate himself to a lazy exporter when energetic ones are clamouring at their doors. They can also demand credit, and normally do. The resources of the country are not vast, and their other suppliers are prepared to provide credit on attractive terms. British exporters will find the Export Credits Guarantee Department of the Board of Trade always ready to assist them. Finally, there seems to be no logical reason why British manufacturers should not be able to secure a large share of the trade which is being offered in this new development plan in Portugal.

Out of the MELTING POT

Of Interest

GREY tin—the form of the metal stable at low temperatures—has come a long way since it used to be mentioned in connection with such unlikely sounding occurrences as the crumbling to dust of tin ingots in store during the winter in some cold country, the disintegration of tin organ pipes in unheated churches and the deterioration of soldered joints and tin coatings in refrigerators. Like many another advance to prominence by what used to be a rare and uncommon element or compound, interest in grey tin and its formation and properties has been due to the discovery in 1950 that the material is a semi-conductor. In this connection the problem of obtaining specimens of grey tin in a form other than the usual powder form has received the attention of a number of investigators. Although coherent samples were made by compressing the powder and by transforming fine wires and thin foils, the crystal perfection of the resulting products was less than that desirable for studying various semi-conductor properties. Attempts to form grey tin crystals directly by depositing the metal by electroplating, vapour condensation or chemical reaction at low temperatures had proved unsuccessful. It has now been reported that small single crystals of grey tin have been grown from a liquid amalgam of the metal. In the apparatus used, movement of the amalgam is arranged to take place between a region at —20°C. in which tin is supplied and dissolved, and another region at —30°C. where grey tin crystallizes out from the amalgam. Crystals up to 2 cm. in size have been grown. After they had been cut to eliminate small pockets of occluded mercury, residual resistance measurements indicated a total impurity content of the order of 0·001 per cent. Studies of the transformation of these crystals of grey tin to white tin suggests that it is of the diffusionless type. Evidence of step-wise motion of the interface separating the two phases—a phenomenon that would be expected in the case of diffusionless transformation—has been observed. Another report published recently has described the carefully controlled conditions under which large crystals of grey tin can be obtained by transformation of specimens of white tin.

Reactions

ALTHOUGH hitherto it has received no attention, the fact is that the Luddite attitude to automation is not confined to operatives on the production lines. It exists also in what might have been expected to be much more enlightened circles. Mention of, for example, automatic literature searching and retrieval, electronic translating machines and, more recently, electronic equipment designed to scan and "abstract" scientific and technical literature, will in most cases provoke quite vigorous reactions from people concerned with such tasks. Broadly, these reactions fall into two groups: the enthusiastic and the critical. Little need be said about the enthusiastic. They spring from the uncritical view that since anything new is designed to be an improvement on what has gone before, it is thereby of necessity better, and therefore to be welcomed with enthusiasm. The critical reactions are more complex. Some of them are undoubtedly the result of a Luddite attitude to mechanization, an attitude compounded of a grudging acknowledgment that such mechanization is preferable to existing methods and will in due course be preferred to them and, in consequence, to those at present responsible for their execution. Some of the critical reactions are, however, just critical, being based on the unpopular view that existing methods of literature searching, abstracting and translating are, and always will be, superior to purely mechanical processes. This may well be so. Unfortunately for the critics, however, whether superior or not, it so happens that mechanical methods fit in better with the current developments in the general scheme of things and will therefore unquestionably be adopted. Whether or not the traditional ways and means will at the same time acquire a scarcity value is very much up to their protagonists.

Supply

CONSIDERING the care that has normally to be taken in order to obtain sound aluminium castings free from porosity, the production of porous aluminium might appear as merely a matter of taking much less care and forgetting all about the need for starting with a dry furnace charge, suitable furnace atmospheres, fluxes, degassing treatments, and the rest. Unfortunately, the matter does not prove to be as simple as that, and the production of porous aluminium or, as it is more correctly referred to, aluminium foam, probably calls for as much, if not more, care and control as the production of sound pore-free castings. In theory, the necessary control could be obtained by reducing the volume of metal requiring to be controlled at any given time, and introducing and dispersing hydrogen or other suitable gas into this volume prior to its solidification. A succession of such volumes would then lead to some form of continuous casting process, the product of which would have a uniformly distributed gas porosity. Also in theory, a uniformly porous product could, alternatively, be built up via a powdered form of the metal, a form which, incidentally, would only need to have a transitory existence (in a vacuum or inert gas atmosphere) as a stage between a melt of the metal and the final product built up by deposition and, if necessary, suitable compaction and forming of the intermediate powder form. Until such time as the above theoretical approaches will have been reduced to practice, the practice of producing foamed aluminium involves the addition to the molten metal of a finely divided foaming agent, such as titanium, zirconium or magnesium hydride. Mixed into the molten metal, the foaming agent is decomposed and releases its hydrogen. The foamed metal is thereupon quickly cast into preheated moulds in which the foaming process is completed and the metal solidifies. Until recently, this practice had been developed and tried on no more than a laboratory or pilot scale, as a result of interest and encouragement on the part of the U.S. Air Force. Both of them having apparently subsided, two companies are now reported to be setting out to undertake production of the material on a substantial scale for civilian applications yet to be developed. One of these companies is, in fact, already turning out some sheet and custom-cast foam products. Aluminium foam weighs about 12 lb/ft^3, compared with 170 lb/ft^3 for the solid pure metal. It can be sawed, nailed, cemented, soldered and brazed. Uses as a fireproof, rotproof substitute for timber, and in machined parts and castings are visualized.

Skimmer

PRODUCTION — CASTING ALLOYS — MELTING — SAND CASTING

Some Aspects of Modern Aluminium Casting

By L. FLETCHER

A brief survey of the present status of aluminium and the relative position of the casting side of the industry, with a review of methods currently being used in aluminium casting shops, are given in this Paper. It was presented at a Symposium on "Recent Developments in Foundry Technology" arranged by the National Metallurgical Laboratory, Jamshedpur, India.

ONE of the most striking features of industrial development during the past decade has been the rapid growth in the use of materials which were formerly confined to certain specialized fields. Among these materials, aluminium can be regarded as outstanding, from the point of view both of rate of growth and the position it now occupies. This can be seen from the fact that in the five years between 1950-1955 the production of primary aluminium in the free world doubled, and in 1956 it stood at 3·1 million short tons, of which 1·7 million tons were produced by the U.S.A. The U.K., although only a minor producer of the metal, consumed 320,000 tons in 1955, most of which was imported.

Figures for primary aluminium do not, however, tell the whole story, since an appreciable amount of aluminium is used in the form of secondary metal. In the U.K., for example, the production of secondary metal in 1956 was 130,000 tons, of which 70 per cent went into cast products. Some idea of the comparative size of the foundry side of the aluminium industry can be gained from the fact that the amount of aluminium appearing in the form of castings is about one-quarter to one-third of the tonnage of wrought products. U.S.A. shipments of castings in 1956 were 400,000 tons, of which sand castings accounted for 86,000, gravity die- (or permanent mould) castings 123,000, and pressure die-castings 188,000. In the U.K., 88,000 tons of aluminium castings were produced in 1956, of which 24,000 tons were sand cast, 47,000 tons gravity die-cast, and 17,000 tons pressure die-cast.

It is pertinent at this point to consider why the world output of aluminium has increased so greatly. The chief reasons are:

(1) The greater availability of the metal as a result of the vast extension of production facilities during and after the war.

(2) Increasing familiarity with aluminium, especially on the part of those formerly accustomed to traditional materals.

(3) Stability of price. Although this, in common with the prices of other industrial raw materials, has gradually risen, it has not suffered the disturbing fluctuations which have affected many other commodities.

(4) Better appreciation of the technical and economic advantages of using aluminium, leading to an ever-widening field of application.

The present trend may be expected to continue as long as production generally is expanding. A further development which will certainly affect the aluminium industry, including the foundry side, is automation. Mechanical aids, such as sand lifters, conveyors, power rammers, sand slingers and the like, are already in

Gravity die-casting foundry

Curing cores for gearbox extension pieces by the carbon dioxide process

TABLE I—COMPOSITION AND PROPERTIES OF SOME TYPICAL ALUMINIUM CASTING ALLOYS

Nominal Composition per cent	Condition	Principal Specification B.S.1490	Sand or Chill	Typical Mechanical Properties			
				0·1 per cent Tensile Proof Stress ton/in.²	Ultimate Tensile Stress ton/in.²	Elongation (on 2 in.) per cent	Izod Impact ft/lb.
Al 99½	M	—	S	2	5	48	14
			C	2	5	55	14
Si 4 Mg ½	M	LM8M	S	5½	9½	3½	—
			C	6½	11½	5½	—
	P	LM8P	S	8½	10½	1½	—
			C	10½	13½	2	—
	W	LM8W	S	7½	11½	4	—
			C	7	14½	10	—
	WP	LM8WP	S	17½	18	1	—
			C	18	20½	2	—
Si 5 Cu 3 Mn ½	M	LM4M	S	5	10½	3½	½
			C	6½	12	—	½
Si 12	M	LM6M	S	4	11½	7	3
			C	5	14	10	6
Si 12 Ni 2½ Cu 1 Mg 1	WP	LM13WP	S	12	13	½	½
			C	17	19	½	1
	WP (special)	LM13WP (special)	S	9	10	½	½
			C	10	13	1	½
Cu 4 Ni 2 Mg 1½	M	LM14M	S	9	11	1	½
			C	9	13	2	½
	WP	LM14WP	S	13½	14½	½	1
			C	15½	20	1	1
	WP (special)	LM14WP (special)	S	—	—	—	—
			C	—	—	—	—
Mg 10	W	LM10W	S	11	20	13	11
			C	11	21	18	—

M=as manufactured. W=solution treated only. WP=solution treated and subsequently precipitation treated. P=precipitation treated.

use. However, the nature of the operations in the sand foundry, and the variety of problems met with, are such that any considerable application of automatic process control—or automation—can be ruled out. With gravity die-casting and, more especially, pressure die-casting the position is different. In suitable instances the die-casting machine could, doubtless, be treated as a machine tool and subjected to automatic control. Even so, there remains the need to apply to the melting and finishing phases of the operation a similar degree of control if full benefit is to be derived from automation.

Casting Alloys

Before going on to describe the processes and equipment available for aluminium casting, the chief casting alloys may be considered. These are always made to a controlled analysis, using a mixture of secondary metal, virgin metal and alloy additions. In specifying an alloy it is desirable to consider not merely the mechanical properties required but also the foundry characteristics of the metal. This approach is not always possible, since the casting may be required to have high strength or good elevated temperature properties, etc., which themselves dictate the type of alloy to be used. The composition and properties of some of the chief alloys are given in Table I.

Pure aluminium is not greatly used for castings since its foundry characteristics are poor, but it finds application for electrical products, particularly squirrel cage rotor windings for fractional horse power electric motors, where the high conductivity of the material is an obvious advantage. The windings are cast around a pack of laminations in a die-casting machine.

From the foundry point of view, the easiest alloys to deal with are those containing silicon, particularly B.S.1490 LM4M and the popular 12 per cent silicon alloy, LM6M. Both are noted for their fluidity and good resistance to corrosive attack. They have fair ductility and, although the strength is relatively low, one of these two alloys is generally specified for general purpose work. The 12 per cent silicon alloy is improved by the addition of about 0·03 per cent of sodium during melting and just before casting. This process, which is known as "modification," refines the structure of the eutectic silicon constituent and improves the resultant properties. The impact strength of LM6M is quite good, and it gives sound pressure die-castings which are largely used for marine and general engineering purposes. Alloy LM4M is very useful where moderate mechanical properties are called for and low cost is important.

For pistons and cylinder heads, material with adequate strength at elevated temperature is needed. Both LM13 and LM14 ("Y" alloy) possess this property; LM13 also has a comparatively low coefficient of thermal expansion and good bearing (frictional) qualities, and is the commonest piston alloy. The properties of the as-cast materials can be improved by heat-treatment, consisting of heating and quenching followed by subsequent ageing or precipitation at an elevated temperature. An alloy much used for pressure die-castings and architectural work and components for aircraft and automobiles is that containing 4 per cent silicon and ½ per cent magnesium. It has good foundry characteristics and takes a high polish, and can be obtained in four conditions, having different mechanical properties. Where high strength is called for, LM10W alloy is specified. Though greater care is required in casting, the mechanical properties of the alloy are very good and similar to those of malleable cast iron. Its corrosion resistance, especially in marine conditions, is also

notable. This material is used for highly stressed parts in aircraft, marine and transport engineering.

Melting and Holding

Melting furnaces for aluminium may be heated by solid fuel, oil, gas or electricity, and they may be directly fired (reverberatory types) or indirectly fired (crucible and pot furnaces), stationary or tilting. In modern foundries, melting down and alloy addition are often carried out in oil-fired reverberatory or crucible units, or in low frequency induction furnaces, and the metal is transferred to heated pots which act as holding furnaces. The method adopted for heating furnaces naturally depends on local conditions and the plant and labour available. Generally speaking, indirect is preferred to direct firing because the metal picks up gas and oxide less easily. Electric melting is superior to other methods because there is little or no contamination of the metal, temperature control is very good, and the working conditions are also more satisfactory. At the same time, however, it must be remembered that neither the reverberatory nor the low frequency induction furnace is suitable for melting where frequent changes in alloy composition are necessary.

Gravity die-casting machine for producing gearbox extension pieces. Die closed, pouring in progress and casting ready for removal from second frame

The low frequency induction furnace can be regarded as the most advanced type of melting or holding unit. It consists essentially of a transformer, the secondary winding of which is formed by the metal contained in a submerged channel communicating with the furnace chamber. Means of draining the channel, removing metallic residues and repairing the lining are provided. It is necessary when starting such a furnace to heat the melting chamber and add a "heel" of molten metal, and to maintain liquid metal in the melting channel throughout the operation of the furnace. A characteristic of this type of unit is the stirring action which results from the induced currents, giving a very homogeneous melt.

Whatever the type of furnace used, it is highly desirable that close temperature control be maintained. Excessive temperature and long holding times cause gas absorption and oxidation of the metal, giving castings with poor mechanical properties.

An important recent development in furnace equipment for die-casting is the use of automatic pouring in place of hand ladling of the metal, typified by the Ajaxomatic casting unit. This unit consists of a thermostatically controlled low frequency induction furnace of 300 lb. (136 kg.) capacity and 20 kW rating, fed with molten metal from a melting furnace. The lid is air-sealed and metal is transferred by introducing compressed air above the melt; this causes a predetermined quantity of molten metal to be forced up the pouring spout from a point below the surface, and so into the chamber of the die-casting machine. The pouring spout is heated to prevent chilling of the molten metal during discharge. The quantity of metal delivered per shot is adjustable between $\frac{1}{4}$ lb. (0·1 kg.) and 20 lb. (9 kg.), and the whole operation is automatic. It is also possible to link the operating cycle of the furnace with that of the die-casting machine.

Gravity die-casting machine for producing gearbox extension pieces. Die opened and core assembled in second frame

Sand Casting

Moulding sands for the foundry are usually obtained from local sources, and may be used as received, or blended with other sands or with clay. Where a suitable sand is not available it may be necessary to make up a synthetic mixture with silica sand and a proportion of clay.

The qualities required of a moulding sand are in some measure contradictory, and a compromise must be made. Thus, permeability is favoured by a low clay content and coarse particle size, whereas a smooth finish calls for a fine sand with, perhaps, a higher clay fraction. Similarly, green strength is improved by the addition of clay up to a certain point, but permeability is reduced. Permeability

Hand operated die for casting pistons, two at a time. The die halves are water-cooled

and green strength depend largely on moisture content, and once a given sand has been standardized, its behaviour can be controlled by routine tests to maintain the moisture content at the correct figure.

Sand casting is invariably used for one-off jobs or castings required in small quantities, because the process is quick, cheap and extremely flexible. However, the tolerances and surface finish are inferior to those of parts produced in metal moulds, and it is not surprising that attempts have been made, particularly in recent years, to retain the advantages of sand casting whilst mitigating its drawbacks.

In one method, the mould is made of plaster of Paris, or a mixture of plaster and sand, which is poured round the pattern in the form of a slurry. Permanent patterns may be used, or patterns of wax or frozen mercury, which is allowed to melt and run out of the mould after it has set. Sometimes rubber or plastics patterns are used for simple re-entrant surfaces where they can be removed without destroying the mould. When the mould has set, it is usually baked in order to improve the porosity: air may be incorporated in the slurry for the same purpose. After the metal has been poured and the casting has solidified, the plaster is broken away and the mould knocked out.

Another development is shell moulding, or the production of moulds consisting of a crust of sand $\frac{1}{8}$ in. to $\frac{3}{8}$ in. thick. The shell is made by applying a mixture of fine sand and powdered phenolic resin to the heated metal pattern, and removing the excess material. The whole is then baked so as to cure the resin and produce a hard shell, which is removed and re-assembled in a box with loose sand or metal shot as the support. The assembled mould is poured in the usual way.

Investment casting, although it has been known in principle for hundreds, if not thousands, of years, has been used to any great extent only recently, and mainly for high precision parts in refractory metals. It can also be used for aluminium. This method of casting employs a mould produced from a pattern of wax, plastics, frozen mercury or other liquefiable material by encasing or investing it with a moulding medium consisting of a refractory slurry. The investment sets round the pattern, which is subsequently removed by melting (a new pattern must be made, from metal dies, for each casting). The mould is heated or otherwise cured, to give it strength; it is then placed in a container supported by sand, etc., and is ready for pouring.

Each of these three latter processes is capable of yielding castings which, in surface finish, fidelity of detail and dimensional tolerances, are comparable to those produced in metal dies. They can, therefore, be regarded as intermediate between ordinary sand moulding and die-casting, and are, in fact, employed where parts with superior dimensional accuracy or finish are required in small numbers. However, these processes usually cannot compete with die-casting when quantities of 1,000 or more are needed; and although high quality castings can be produced, the materials used are more expensive and the skill required is greater than for ordinary sand casting.

One other development worth mentioning is the carbon dioxide curing of sand cores. In this process, the core sand is mixed with a sodium silicate solution, and carbon dioxide gas is injected into the core. The carbon dioxide reacts with the sodium silicate to produce gelatinous silica, which is deposited around the sand grains, thus binding them together. Cores made in this way are ready for immediate use, and do not require any baking or further treatment. Drying ovens can largely be dispensed with and the output of the core shop increased. The process is particularly valuable for making die-cast products which require sand cores.

(To be concluded)

Research Programmes

A CHANGE in organization affecting two D.S.I.R. Laboratories is announced by The Council for Scientific and Industrial Research. Small Steering Committees are being set up to bear responsibility for the research programmes at the new Warren Spring Laboratory, at Stevenage, and at the recently renamed National Chemical Laboratory, at Teddington.

Under the former system Research Boards, which the Steering Committees replace, were responsible to the Research Council, but there was not necessarily any common membership. It is an essential feature of the new arrangement that the Steering Committees are full committees of the Research Council and that there will be a direct link between the two bodies, because the Chairmen of the Committees are members of the Council.

In addition to the Chairman there will be four members of each Committee. Two will be from industry and will have experience in research management. The other two members will be the Secretary of the Department of Scientific and Industrial Research and the Director of the Laboratory.

The Warren Spring Laboratory Steering Committee is composed of the following:— **Sir Harry Jephcott,** D.Sc., F.R.I.C. (Chairman), **Dr. R. Holroyd,** M.Sc., Ph.D., **Mr. D. A. Oliver,** C.B.E., M.Sc., F.I.M., F. Inst.P., the secretary of the D.S.I.R., and the director of the Warren Spring Laboratory, **Mr. S. H. Clarke,** C.B.E., M.Sc.

Sir Harry Jephcott is chairman of the Research Council, and chairman of Glaxo Laboratories Ltd.

Dr. Holroyd is deputy chairman of Imperial Chemical Industries Ltd., Mr. Oliver is Director of Research of the B.S.A. Group Research Centre.

The National Chemical Laboratory Steering Committee will be as follows:— **Professor C. E. H. Bawn,** C.B.E., Ph.D., F.R.S., as chairman, **Dr. F. Roffey,** Ph.D., F.R.I.C., **Mr. B. Topley,** M.A., F.R.I.C., the secretary of the D.S.I.R., and the director of the National Chemical Laboratory, **Dr. D. D. Pratt,** C.B.E., Ph.D.

Professor Bawn is a member of the Research Council. He is Professor of Inorganic and Physical Chemistry at the University of Liverpool. Dr. Roffey is Research and Personnel Director of the Distillers Co. Ltd. Mr. Topley is Director of Development of Albright and Wilson Ltd.

Research Progress

Hydrogen in Titanium

BY RECORDER

IN the early stages of the commercial development of titanium and its alloys, the hydrogen contents of these materials were not thought to be important since no abnormal effects on standard physical and mechanical properties had been observed even at very high concentrations. Later it was found, however, that high hydrogen contents adversely affected ductility under certain straining conditions, notably at low strain rates (particularly in alpha-beta alloys) but also in impact tests on commercial purity titanium. Naturally, after this discovery, extensive research was carried out to determine the permissible hydrogen levels in the common alloys and also to develop manufacturing methods which would minimize hydrogen pick-up.

Sources of Contamination

It was found that although the susceptibility to hydrogen embrittlement varied from alloy to alloy, contents up to about 200 p.p.m. could be regarded as safe for any material. Hydrogen pick-up was found likely to occur principally at two stages in the production of a finished titanium component. First during the extraction of the metal from its ores, particularly if aqueous leaching of the reaction products is used: second in the hot-working operations following melting. Hydrogen arising from the first of these sources can be almost completely removed by melting *in vacuo* and this has been one of the main factors responsible for the virtually universal use of vacuum melting for titanium and its alloys. Hydrogen introduced during hot-working, however, can be removed only by a subsequent heat-treatment that requires expensive specialized furnace equipment, and every effort is therefore made to minimize pick-up during hot-working. Nevertheless, it is to be expected that on occasion, material containing an unacceptably high amount of hydrogen will be produced especially in the manufacture of thin, hard alloy sheet. The rates of removal of hydrogen from titanium alloys at various temperatures are thus of practical importance and they have been measured for a number of commercial materials by W. M. Albrecht and M. W. Mallett[1].

Hydrogen Solubility

The major variables likely to influence the rate of hydrogen removal from a titanium alloy are the temperature—which will affect internal diffusion rates and desorption rates at surfaces—the partial pressure of hydrogen at the surface, the lattice structure and presence of alloying elements and the existence of surface films e.g. of oxide. Each of these was studied by Albrecht and Mallett who also determined the solubility of hydrogen in commercial purity titanium and five alloys at temperatures in the range 600°-1000°C. and at partial pressures of hydrogen between 0·05 and 10 microns Hg. Extensive measurements on the commercial purity material and on 8 Mn, 4 Mn-4 Al and 5 Al-2·5 Sn alloys showed that in each case the hydrogen solubility was directly proportional to the square root of the hydrogen pressure. For the alloys, the solubilities appeared to vary with the amount of beta phase present. Thus the solubility of hydrogen in the 8 per cent manganese alloy was greater than in the 4 Al-4 Mn material which in turn gave a higher solubility than the predominantly alpha-phase 5 Al-2·5 Sn alloy. For the last two alloys also the solubilities increased fairly substantially in the range 800°-1000°C., an effect the authors attribute to the presence of the alpha to beta transformation.

The view that the solubility is dependent on the amount of beta phase present appears, however, to be open to criticism and neglects the apparently strong influence of aluminium content. The solubilities for the alloys actually vary inversely (at a given temperature and hydrogen pressure) with the aluminium content even when all are in the all-beta field and the 4 Al-4 Mn material shows lower solubilities than the commercially pure titanium at temperatures where the former would be alpha-beta and the latter alpha only.

Vacuum Degassing

Degassing experiments were carried out on the same materials mentioned above, using small cylindrical specimens and a vacuum of 10^{-5}-10^{-6} mm. Hg. It is not clear what initial hydrogen contents were employed nor how these were obtained though the authors do state that in work on iodide titanium, this material contained originally about 300 p.p.m. hydrogen. The results are, however, presented in the form of "degassing coefficients" D where

$$\log_{10} C/C_o = -0{\cdot}252 - \left(\frac{4{\cdot}28}{l^2} + \frac{2{\cdot}52}{R^2}\right)Dt,$$

C_o and C being the hydrogen contents at the start and after t seconds degassing respectively and l and R the specimen length and radius respectively. This equation is said to be valid for long degassing times and its use may therefore be suspect for some of the results obtained at high temperatures where all but a few parts per million hydrogen would be removed within a few seconds.

The term degassing coefficient is used by Albrecht and Mallett because the values obtained for iodide titanium are lower than the diffusion coefficients determined by Wasilewski and Kehl using an absorption technique[2]. The discrepancy is assumed to be due to variations in diffusion coefficient with hydrogen concentration though Wasilewski and Kehl were in fact, not able to demonstrate a regular relationship of this kind.

The degassing coefficients at 700°C. were of the order of 10^{-5} cm²/sec. and, for the alloys, appear to vary inversely with the low-pressure solubility of hydrogen. The results for iodide titanium are exceptional, however, being appreciably higher than for any of the other materials tested at degassing temperatures exceeding 650°C. Albrecht and Mallett state that "abnormally low" degassing rates were obtained with iodide titanium at temperatures below 650°C. but unfortunately they have omitted to give the relevant data. They suggest that the anomaly may be due to a surface effect though a preliminary treatment at 800°C. for 2 min. (which should allow any oxide film to be removed by solution) did not affect the degassing rate at 600°C. Further evidence on this point is presented, however, for iodide titanium, a commercial purity material and the 8 Mn alloy. A 3 hr. treatment at 790°C. in air gave in each case an oxide film estimated to be about 0·0001 in. thick: subsequent degassing at 700°C. showed that the rate of removal of hydrogen had been substantially reduced by this treatment and indeed no hydrogen evolution could be detected from the iodide specimen. However, a similar but less severe pre-oxidation again of iodide titanium (1 hr. at 675°C.) was found not to affect the subsequent degassing rate. Since in practice, the presence of appreciable quantities of hydrogen is likely to be accompanied by oxygen-rich surface layers, this point might well have repayed detailed examination. The lack of information regarding the effects of surface films which may be present in practice reduces somewhat the value of charts given in the Paper from which the fraction of hydrogen remaining in cylindrical or plate specimens after a given degassing treatment can be calculated directly if the degassing coefficient is known.

Argon Degassing

Finally, the authors describe experiments in which an inert gas stream was used for degassing rather than vacuum

(*Continued on page* 138)

Products and Processes

TRENDS IN THE DEVELOPMENT, APPLICATION, PROCESSING, DESIGN AND WORKING OF NON-FERROUS METALS AND THEIR PRODUCTS

Liquid Nitrogen Aids Wire Manufacturers

DURING the hot-dip galvanizing process in the wire-drawing industry, wire is drawn through a bath of molten zinc. When this bath or kettle becomes overheated, the zinc tends to attack the kettle surface, and there is a risk of bursting and consequent leakage of the metal.

The amount of zinc resulting from this leakage, known as a spill, can be quite large if the leak is not plugged quickly. Since it is a very ductile metal, it is difficult to break the spill by normal methods.

One answer to the problem, however, is to freeze the spill with liquid nitrogen. This has the effect of rendering the metal brittle, and it can then be broken up by means of a sledgehammer.

John Rigby and Sons Limited, the Bradford wire manufacturers, sought the advice of British Oxygen Gases Limited recently when they were confronted with a spill weighing ten tons.

Liquid nitrogen was poured from a tanker on to the surface of the spill, gradually working from the outer surface to the centre. In this way, the mass of zinc was reduced to small sections with comparative ease.

When work of this nature is carried out in a confined space, precautions must be taken to ensure that operators do not inhale too much nitrogen gas. It must also be borne in mind that the surface of the zinc becomes extremely cold following the application of liquid nitrogen and can cause permanent damage if it is allowed to contact the skin.

This method of the reduction of scrap by extreme cold may well be applied in other industries to other normally ductile metals which have to be broken up.

Tube Cleaning

DESIGNED specifically for use on small straight tubes having internal diameters from 0·495 to 1·820 in. and curved tubes with internal diameters of from 0·791 to 2·080 in. having a minimum radius of 6 in., the 600 series of Lagonda tube cleaning equipment manufactured by Consolidated Pneumatic Tool Co. Ltd., includes short and long bodied units which house miniature vane type air motors, the short motors being used for curved tubes and the long motors for straight tubes, both the motors and the cutters with which they are used being designed to ensure optimum use of maximum power.

For cleaning in the tube range of $1\frac{3}{4}$ to $3\frac{5}{8}$ in. I.D. for both straight and curved tubes the 1300 series motor has been produced; for larger tubes of over $4\frac{1}{4}$ in. I.D. sleeves are fitted over the motors. A force feed oil lubrication system delivering oil under pressure to the bearings is a particular feature which, together with a simple construction of the vane motor, keeps maintenance to a minimum.

A range of heavy duty motors known as the 1100 series deals with straight tubes only in the size range of $2\frac{1}{4}$ to 6 in. I.D. In this motor, developed originally for refinery service, ball thrust bearings at both ends accommodate rotor drag due to operator thrust when working a heavy deposit and prevent friction due to pulling of the self feeding cutter heads, the bearings being lubricated by forced feed.

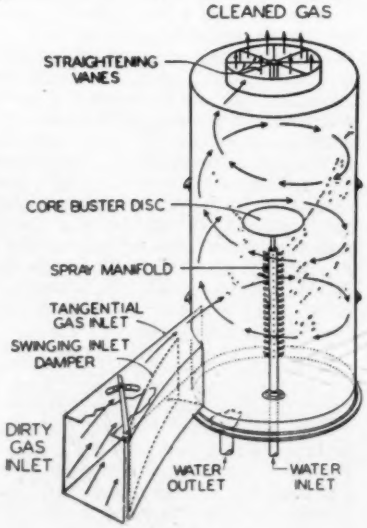
A very wide selection of cutter heads and brushes is available. All cutter heads are, however, variations of straight and trackless cone cutters in which the spacing of the cutter teeth or blades is so arranged that any one tooth does not return to the same point in a tube in successive revolutions of the head. This prevents the formation of a tooth design in the tube and ensures an even finish. For straight tubes, the cutter heads are direct coupled to the shaft of the motor used, whilst to obtain flexibility in curved tubes, a universal joint is always used between the cleaner motor and the cutter.

Left: Tube cleaning equipment in the new Consolidated Pneumatic-Lagonda range. The smallest motor is an example of the 600 series, that in the centre is an 1100 series motor. Also shown is a 1300 series motor. The units are fitted with an expanding brush and pivoted arm and swing frame type cutters respectively

Removal of Dirt and Dust from Gases

NOW being successfully used in a wide range of industries in the U.S.A. the Pease-Anthony Cyclonic Scrubber and the newer Pease-Anthony Venturi Scrubber are designed for the highly efficient removal of micron and sub-micron dusts, fumes, mists and fogs from gas streams. The apparatus is equally effective for the reduction of air pollution and for cleaning industrial gases; it also enables valuable metals and chemicals to be recovered.

In the cyclonic scrubber, dirty gas enters tangentially at the bottom of the scrubber and pursues a spiral path upwards. Spray is introduced into the rotating gas from an axially-located manifold in the lower part of the unit. The fine spray droplets are caught in the gas stream and by



Right: Diagram showing arrangement of Chemico Pease-Anthony gas scrubbing equipment

centrifugal force are swept across to the wall of the cylinder, colliding with, and collecting, the dust particles on route. The water and collected dust run down the walls and out at the bottom of the unit.

The cyclonic scrubber is well suited to the removal of dusts and mists of micron size when it will give very high removal efficiencies often above 99 per cent, with small pressure losses and consequently low power requirements.

Amongst the many applications for which the cyclonic scrubber has been installed, involving over 100 units and 3 million ft^3/min of gas, is the removal of lime dust from lime kiln gases, the recovery of lead compounds from reverberatory furnaces and the removal of ammonium nitrate from rotary dryer gases.

In the venturi scrubber, dirty gas at high velocity, impinges upon and atomizes a curtain of liquid introduced through jets at the throat of the venturi. Differential velocities of gas and atomized liquid result in collision of mist or dust particles with liquid droplets. The coalescence of mist or agglomeration of dust resulting from this collision make simple cyclonic separation possible. For even the most difficult scrubbing jobs it assures almost complete removal of sub-micron dust and mist.

Examples of the applications to which the scrubber has been put are the removal of fume and iron oxide dust from blast furnace and oxygen steel converter gases, amine recovery from dry ice and CO_2 plants, the removal of phosphoric and sulphuric acid mists from concentrators; naphthaline, coke and tar removal from coke oven gas and chemical fumes from detergent spray dryers.

This equipment is manufactured by Chemical Construction (Great Britain) Ltd., under licence from The Chemical Construction Corporation of New York.

Fitting Aluminium Conductor Accessories

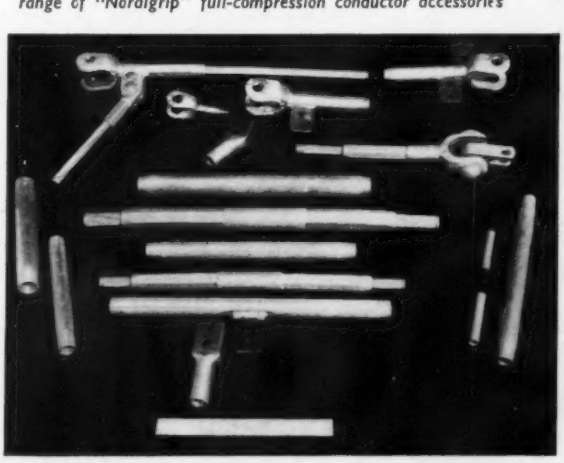
THE introduction of a new range of full-compression conductor accessories that are cheaper, lighter, and more quickly compressed, than those previously available, is announced by Northern Aluminium Company Limited.

Known as the "Noralgrip" range, these new compression fittings supersede the former "Tubular" accessories and have been approved, following extensive electrical and mechanical tests, by the Central Electricity Generating Board for inclusion in its Standard Components Scheme.

"Noralgrip" accessories are designed for use on extra-high voltage overhead aluminium transmission lines and earthwire conductors, and include dead ends (both single and double-jumper terminal types), midspan joints, and disconnectable non-tension joints.

Right: The Noral motorized hydraulic compressor shown fitting a "Noralgrip" dead-end, using a fixed 100-ton ram head. Control of the lifting and lowering of the ram is operated by a single lever. The cast aluminium alloy housing contains the pump unit and also serves as an oil bath and oil reservoir

Below: A group of compressed and uncompressed items from the new range of "Noralgrip" full-compression conductor accessories



These new fittings possess several important advantages over the previous range. They are smaller and lighter, without sacrificing any mechanical strength, and they are in general therefore considerably lower in cost. In addition, the "Noralgrip" fittings can be applied more quickly with standard compressors, and compression time can be reduced to a fraction if the new Noral motorized hydraulic compressor is used. As with earlier designs of Noral fittings, these joints are compressed hexagonally, since this type of forming ensures a fully homogeneous joint.

Further time-saving is afforded, and a reliable connection ensured, by avoiding the need for contact-preparation in the field, dead-end lugs and jumper terminal contact surfaces being pre-treated before leaving the factory, and the surfaces then protected by a strippable plastics film. Steel compression components are pre-filled with "Unigrip C" jointing compound, the ends of the joints being capped with strippable plastics.

To facilitate the fitting of the new range of conductor accessories, or similar applications requiring a portable supply of high-pressure hydraulic power, a portable hydraulic power unit has been introduced.

This robust piece of equipment can cut compression time to a fraction of that required to apply a fitting by the standard manually-operated compressor.

The unit consists of two plunger-type pumps driven by an eccentric shaft and reduction gearing. This is enclosed in a cast aluminium alloy housing that serves both as an oil bath and oil reservoir.

Power is supplied by a Villiers Model 7F, two-stroke constant-speed motor of 2 b.h.p. output, mounted on top of the housing and fitted with a recoil starter. Alternatively, an electric motor of suitable capacity may be fitted to suit workshop conditions or personal preference.

The pump is capable of generating hydraulic pressure up to a rated capacity of 7,800 lb/in^2 of ram area, automatic relief valves operating at this pressure to prevent damage. Control of ram lifting and lowering is effected by a single lever.

Connection between the power unit and the operating head is by means of an oil-resistant, rubber-covered, double-wire-braided, high-pressure hose, fitted at each end with disconnectable cone couplings. This hose is supplied to suit individual requirements up to seventy feet in length.

The unit and motor are mounted on a welded tubular chassis together with a 100-ton capacity ram head which is connected to the pump unit by a short length of the special pressure-hose. This short hose can be quickly disconnected and, for overhead line work, a longer hose can be readily fitted for use with any ram head which has, or is capable of being fitted with, a male-type half-inch British Standard pipe connection.

Pressure Die-Casting Review

Design of Die-Castings

VIII—Designing Die-Castings for Easy Finishing

By H. K. BARTON

(*Concluded from* METAL INDUSTRY, 18 *July*, 1958)

THE desirability of arranging matters so that secondary flash is formed only at positions from which it is readily removed is, of course, obvious, but it is often not obvious to the designer what location will, in fact, give easy finishing and, at the same time, will not unduly complicate tool construction. Even where the feature concerned is a very simple one, a fairly thick-walled cored boss, for example, there is a very wide choice of flash-lines, and to determine the best it is necessary to decide upon the mode of finishing to be adopted. It is, therefore, best to discuss matters of this sort with the die-caster while the component is still on the drawing board; merely to leave it to the die-caster is not satisfactory, since whatever design for the profile of the part is decided upon will limit his choice in some degree.

Thus, we may take as an example the casting of which part appears in Fig. 11 (*a*); this is a boss formed in a cavity split between the die members and having a slightly-tapered bore formed by a moving core. Part of the way down the external wall is a shallow groove. Even before a tentative sketch of this sort can be made, several decisions must, deliberately or tacitly, have been made. Thus, the top of the boss is shown flat, with its outside edge at right-angles to the external wall and the central bore, but none of these three features is inevitable. To give only one or two alternatives, the edges of the face might well be bevelled (as at *b*) or radiused as in sketch *c*, whilst either of these latter, or a combination of both, could perfectly well be combined with, say, a castellated annulus on the end face. Although none of these possible variants absolutely determines the position of secondary flash, each makes certain locations more desirable than others.

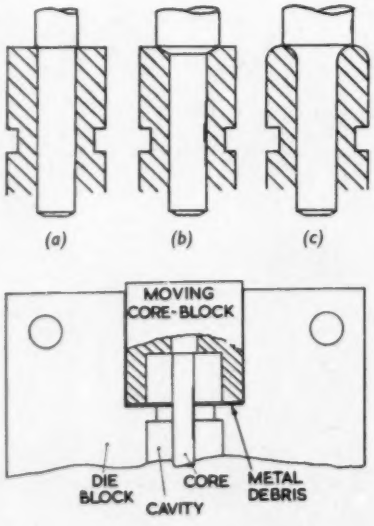
It is not possible, in practice, to make a decision in such matters without considering, in addition to ease of flash removal, the effect of the possible joint-lines on the dimensional accuracy of the component. If it should be that concentricity of the bore and the outside diameter are more important than, say, the depth of the end-face to the internal shoulder, the die construction can be such as to guarantee the first within close limits whilst requiring wider tolerances on the second. In this specific instance, it would then be necessary to form the bore and the external surface down to the top edge of the annular groove, in the same die element, and to make this slidable at right angles to the two main die members.

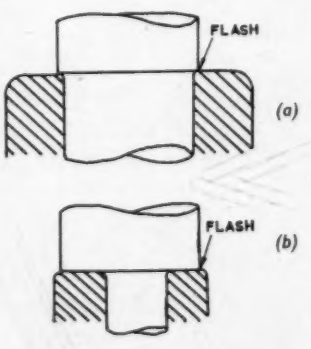
As Fig. 12 shows, this results in a flash-plane occurring at the top edge of the groove and normal to the axis of the core. Normally, this is a most unsatisfactory location, first, because flash at such a position can seldom be cleanly removed without rotating the casting about the axis of the cored hole, and second, because a butting joint in the die, as in the figure, is subject to the lodging of metal debris between the joint faces. There is thus a tendency for the thickness of the flash to vary between unacceptably wide limits, becoming greater as fragments of metal accumulate. After some cycles, the gap may become large enough for a complete flash sheet to form in the joint; this then comes away with all the debris previously formed and at the next cycle closure is more complete. However, repeated cycles of this sort throw a great strain upon the die mechanism, and eventually a heavy flash is formed on every casting.

To remove this effectively without a machining operation is difficult, so that little or nothing is gained by adopting the boss form of Fig. 12 that could not be achieved by running a piloted hollow mill over the end of the boss to impart the desired concentricity. Moreover, whereas concentricity between inner and outer diameters can only be held down to the level of the groove in the first case, the hollow mill can be used to size and centre the whole outside diameter of the boss, if desired. The groove itself cannot, in either case, be held to closer limits than those normally held between points in opposed die members.

Much the same considerations apply to any flash-plane normal to the axis, but it is often particularly unsatisfactory to bring the flash off in the plane of the top face since any operation for its removal, short of lathe-turning, tends to leave an uneven and poorly-defined edge. So far as possible, therefore, the profile of components should permit some part at least of the end-faces of bosses to be formed in the main die-members. Convenient profiles are more those of Fig. 13, with the outside radius formed in the main die and the inner one on the core.

So far as flash removal is concerned, the exact diameter of the core-shank at its intersection with the main die members is not of very great importance; however, if the bore is less than ½ in. or so in diameter, it is advantageous to make the shank of the core fairly large, as shown at *b*. This facilitates the transfer of heat from the working-end of the core to the rear end and so promotes internal soundness. In the case of large bores, as at *a*, it is common, where a defined





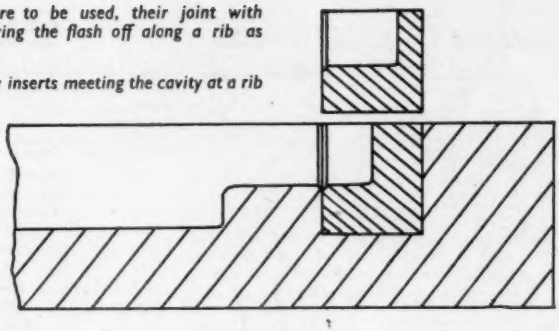
Left: Fig. 11—The shape of a core at the cavity intersection determines the exact position of secondary flash

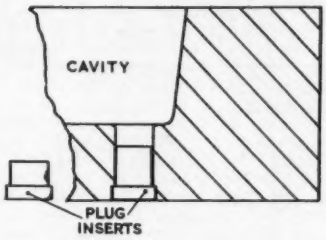
Bottom left: Fig. 12—Heavy flash may be formed at locations such as that shown

Below: Fig. 13—Large cores need only a small shoulder; small cores should normally have large shanks for efficient thermal conduction

Left: Fig. 14—When cavity inserts are to be used, their joint with the main cavity should preferably bring the flash off along a rib as here shown

Right: Fig. 15—Interchangeable cavity inserts meeting the cavity at a rib





Left: Fig. 16—Interchangeable plugs alter the length of a cast boss

radius is not essential, to make the shoulder at the cavity intersection as little as 0·015 in. This is enough to prevent metal being dragged into the hole—which would cause the core to seize up—and avoids the use of unnecessarily large diameter stock.

If, therefore, a boss is to be cored out $\frac{3}{4}$ in. or so in diameter, it is helpful if the radius at the mouth be held to a minimum, or the edge merely broken. In this connection it may be noted that, should it be necessary to ream the bore, or face off the boss to hold a critical dimension, minor changes in profile can be made at the same time by incorporating a form-cutter in the tool. This is largely a procedure that is left to the die-caster, who carries out such secondary machining operations as may prove necessary to produce a component meeting the agreed specification. With the development of small, easily assembled machining heads, often provided with a pneumatic traverse, it is becoming increasingly preferable from the die-caster's viewpoint to produce castings at high speed, with the emphasis on soundness and good finish, rather than more slowly to an inordinately high level of dimensional precision. Critical faces of the part are then machined to bring them within limits, a procedure that is well justified by the better utilization of the die-casting machines that results.

It is sometimes advantageous, nevertheless, for minor operations of this sort to be carried out by the purchaser. This allows small variations in form—such as are often called for when a single die-cast component is used as a replacement in several elements of a particular assembly—to be incorporated in the part as used. It might well happen, for example, that a component bearing an annular groove, as in Fig. 11, formed part of several successive models of a mechanism, though the dimensions of the groove had varied from model to model. In such instances, it has usually proved preferable to cast the smallest groove slightly undersize, and enlarge as required for the various models, rather than cast the part solid and machine each groove right out.

This last course is, indeed, seldom satisfactory, and cuts of more than 0·010 in. are hardly ever taken from die-cast components since heavy cuts not only remove the strong and dense chilled skin, but often uncover porous areas in the underlying layers. If it is envisaged that major machining operations will be carried out upon a die-casting, it is essential that fully-dimensioned drawings of the *finished* part, as well as details of the as-cast part, be supplied to the die-casters who will be tendering. This is of particular importance when the procedure envisaged is to use one die-casting as a basis for two or more finished parts having some differences in detailed form. This is not an uncommon procedure in foundry work, for when castings are in any case to be machined all over, it is often easy to produce several distinct components from one pattern of rough casting. However, to carry over this outlook to the die-casting process may easily prove disastrous.

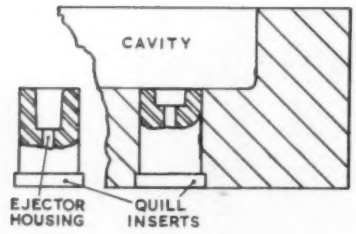
An instance comes to mind in which a customer shipped back to his die-caster, as unsatisfactory, some twenty thousand heavy-section die-castings of a tubular character, each of which had had half-an-inch sawn from one end. As the wall thickness was in the region of $\frac{3}{16}$ in., there was visible porosity in each cut face. Enquiry elicited the fact that the components, previously sandcast, were required in two lengths and that it was the buyer's invariable practice (since he was unable to predict his exact requirements of each) to buy one length of casting only and to cut off short to produce the variant pattern. Needless to say, he had not bothered to mention this to the die-caster when placing the order. Although the litigation that was threatened did not in this case eventuate, the matter was wholly unsatisfactory to both parties. It was the more unfortunate because variant designs of a component can often be produced very easily indeed from a single die by using stop-off blocks, interchangeable inserts, or in some cases merely by interchanging core-blocks.

Whichever of these methods seems the most suitable in a given application, it should be remembered that the joint at the junction between the main die and an interchangeable element is always a little slacker than would be the case with a permanent assembly. A thin fin of flash is common at such junctions, and it is, therefore, best to locate the joint in such a way that the flash can easily be removed. The simplest method of achieving this is often that of Fig. 14, where the junction is coincident with a rib on the casting. This course is not open to the same objections as the similar junction between a moving core and the main die member shown in Fig. 12, since axial displacement of the interchangeable insert (Fig. 15) cannot occur and, in consequence, the fin of flash formed remains thin and brittle.

If the question is merely one of shortening and lengthening some feature of substantially constant section—the height of a boss or something of that sort—it is usually best to design the end face with an unradiused edge so that the change can be made by simply changing the length of the plug that closes the cavity, as indicated in Fig. 16. If the feature in question is of small size, as, for example, when it is desired to produce a component with integral rivets of two distinct lengths, the whole cavity may be formed (Fig. 17) within a replaceable quill. It is in most cases necessary to provide ejectors at such locations, so that a light flash is likely to be formed around the ejector.

The use of quills, or what are sometimes termed "pill-box" die inserts, is also possible when the design variations affect the cross-section, rather than the length, of some feature. The commonest case is, of course, the provision of bosses or spigots with two or more distinct diameters. To achieve this, the main die insert containing the cavity is bored right through to an appropriate diameter; a circular insert carrying the boss cavity is placed in position and secured from the rear of the die block proper. This facilitates its removal without disturbing the main cavity insert.

The junction of "pill-box" and cavity can seldom be masked completely, but by using cylindrical inserts it is possible to get so good a fit that very little flash is formed until the die has been in commission a very long time. The light fin that eventually appears can usually be removed without trace during normal polishing for plating. It is usually worth while on parts that are to be given organic finishes to make sure that the fin can



Left: Fig. 17—Quill or "pill-box" inserts enable small changes in cavity form to be made with ease

Right: Fig. 19—The provision of a bead facilitates clean trimming

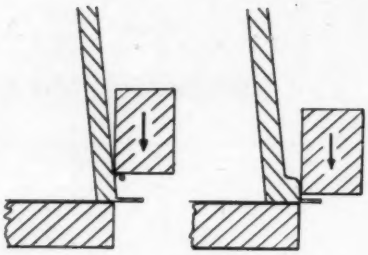


Fig. 18—The junction of the inserts, shown in broken line, conforms with steps or ribs on the surface of the casting

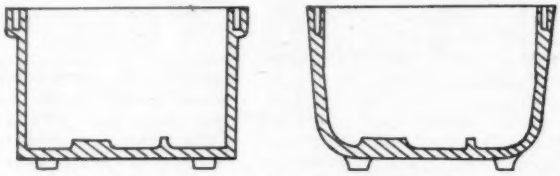


Fig. 20—Rounded contours rather than angular ones are on nearly all counts to be preferred when designing diecast housings

be cleared easily, and to this end an annular rib at the junction, or a low shoulder—both being illustrated in Fig. 18—may be incorporated.

In either case, by raising the flash-line above the general level of the surface the removal of frays is made easier; this also applies in some measure to flash formed at the main die parting, and thus susceptible of being die-trimmed. Although the occasions when a component can be provided with a peripheral rib or bead are rather restricted, such features are well worth incorporating when practicable. Their value lies not in bringing the flash off in a position from which it can easily be trimmed—though, of course, they do serve this purpose—but rather in the fact that they minimize the effect of minor displacements between the die members.

It often happens that in trimming deep-walled castings having little taper, the shear edge of the tool contacts the die-casting at a point some distance from the flash-line. The tool, therefore, face-broaches the casting before coming into contact with the flash proper (Fig. 19 *a*), and although only a few thousandths of an inch of metal may be removed, the appearance of the component suffers. Moreover, the removal of the outer skin occasionally uncovers micro-porosity which, although not visible during polishing, shows up when the component is copper-plated. It is common practice in the U.S. to circumvent this fault (this occurs only when the die is worn and has lost precise registration between the two halves) by using trimming tools into which the component fits quite loosely. The flash, although cleanly sheared, is not taken off flush with the wall of the casting, and a rib that may be anything up to 0·008 in. high is left around part of the periphery. This greatly facilitates trimming and in few cases only is a disability. However, it is a procedure that has not commended itself to British users of die-castings, and the alternative of providing a rib or bead to keep the shear edge away from the casting proper (Fig. 19 *b*) does enable a close trim to be achieved.

Even with appreciable misregistration, only the crest of the rib suffers; when the component is to be polished and plated, the rib readily re-assumes a smoothly rounded contour under the buffing wheel. In the case of parts that are used in the as-cast state, the sheared face of the rib is far less objectionable, being so small in extent, than the usual scraped surface that results from misalignment. The actual form of the rib is not of great importance, though it should obviously have a fairly narrow crest in order to reduce the shear area. The flank contours should be such as to allow easy location in the tool.

Whatever the method of finishing that is to be used, it is always preferable to adopt gently rounded contours rather than to employ a variety of flat faces meeting along hard edges. Even in box-like components previously built up from flat sheet, it should be carefully assessed whether, in fact, the angular form is functionally justified. Quite often the simplicity of such shapes results in their being carried over to a die-cast design, to the detriment of the resulting component. It is often found on enquiry that the internal angles of such items as switch-boxes, meter housings, and the like are quite empty when assembly is completed, and that there is no real reason why the section should have been as on the left of Fig. 20, rather than along the lines of the right-hand sketch, except that the draughtsman felt obscurely that the latter did not look "boxy" enough. It is noteworthy that the cover portions of such assemblies are frequently much better designed than the actual housing portion.

There is no doubt, of course, that many die-casters are not worried by matters of this sort and are content, as they say, to make castings any shape that the customer wants. This attitude masquerades as "service," but is actually sheer laziness; it is, in fact, doing a disservice to the customer to accept a design which, of its nature, will reduce the efficiency of production. It may seem only a small thing that a casting should have the section on the left of Fig. 20 instead of that on the right, but by adopting the one rather than the other, the designer may easily be determining whether the die will produce only 300,000 components before failure, or half a million. Smoothly rounded contours not only have their obvious effect upon ease of polishing, and ease of handling between operations, but also help to mitigate the severe thermal stresses that occur in a die cavity when a stream of metal little below red heat suddenly impinges upon one small area of it.

Research Progress

—*continued from page* 133

treatment. The results obtained demonstrate that substantial reductions in hydrogen content can be achieved in this way but that for a given time and temperature a more efficient removal is obtained under vacuum conditions. Since a treatment of 4 hr. at 700°C. in argon flowing at a rate of 35 L/min. was required to reduce the hydrogen content of a 1 in. long $\frac{3}{8}$ in. dia. specimen of commercially pure titanium from 300 p.p.m. to 40 p.p.m. it seems unlikely that this method offers worthwhile advantages over vacuum degassing.

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Industrial News *Home and Overseas*

Technical Data Sheets

A new series of technical data sheets on the subject of low temperature silver brazing has been issued by **Johnson, Matthey and Company Ltd.** These data sheets will provide detailed comprehensive information on all aspects of silver brazing. Some of the sheets will deal with design and material selection, others with the solution of specific silver brazing problems. All should be of considerable interest to manufacturers employing, or considering the employment of, low temperature silver brazing methods.

The new sheets are available to anyone not already on the company's mailing list for silver brazing information on application to the Publicity Department at the company's head office at 73/83 Hatton Garden, E.C.1.

Formation of Separate Companies

As from the beginning of this month the industrial furnaces and engineers' tools divisions of **Brayshaw Furnaces & Tools, Ltd.,** commenced trading as separate companies under the names of Brayshaw Furnaces Ltd., and Brayshaw Tools, Ltd. The formation of separate companies takes place in the Diamond Jubilee year of the foundation of the original company and has been adopted in view of the continuous development and expansion in both the furnace and tool trade which has taken place, particularly during recent years.

Mr. F. I'Anson, sales manager of the furnace division, will continue to control home and export sales of Brayshaw Furnaces Ltd., whilst Mr. W. Nunn, formerly export sales manager of the tools division, is appointed home and export sales manager of Brayshaw Tools, Ltd.

The registered office of the two new companies will continue to be located at Belle Vue Works, Manchester, which have been considerably extended and re-equipped with a view to providing increased production capacity and modern office accommodation. A branch office for Brayshaw Furnaces Ltd., has also been opened at 84 Blonk Street, Sheffield, 3. To provide additional facilities for furnace repair and service, particularly in the Sheffield and surrounding territory, a repair and service depot is now operating at Northfield Road, Rotherham. The depot will undertake all classes of furnace repair work, servicing and the conversion of existing plant to either gas or oil heating, and is fully equipped to carry out prompt and speedy repairs to all types of furnaces.

Marine and Power Engineers

An interesting function will take place next month in the United States when the sixteenth meeting of Marine and Power Engineers, organized by the **International Nickel Company, Inc.,** will be held at Wrightsville, near Wilmington, North Carolina, during the week September 22 to 27. These meetings are a popular event in the United States and are arranged to discuss corrosion problems, together with inspection of the corrosion testing stations at Kure Beach and Harbor Island. This year invitations have been extended to engineering concerns in Great Britain and Europe to participate in this meeting and among those attending from this country are Mr. J. Arnott, chief metallurgist of G. and J. Weir Ltd.; Mr. F. Hudson, metallurgical engineer, The Mond Nickel Co. Ltd.; Mr. L. Kenworthy, from the Admiralty Materials Laboratory at Poole; Mr. A. M. McConnell, assistant chief metallurgist at G. and J. Weir Ltd.; Mr. W. J. Roberts, from Lloyds Register of Shipping; Mr. J. F. Stanners, from the British Iron and Steel Research Association; and Mr. A. P. Wright, chairman and managing director of T. M. Birkett, Billington and Newton Ltd.

The agenda for the discussions at the technical sessions will include suitable materials (including castings) for use in evaporators, steam turbines, condensers, boilers, pumps and valves, etc. A special session will cover the problems arising in the production of high-tensile aluminium bronze castings, such as marine propellers, and the advantages which arise through the use of these. The subject of cathodic protection will also receive prominent attention.

Previous to the technical sessions a week of works visits and on the spot discussions, beginnings on September 15, have been arranged for the benefit of European delegates to such concerns as Brooklyn Navy Yard, Bethlehem Shipbuilding Co., Philadelphia Navy Yard, Newport News Shipbuilding Co., Bayonne Laboratory of the International Nickel Co. Inc., etc.

Others interested in attending this meeting should get in touch immediately with Mr. F. Hudson, Development and Research Department, The Mond Nickel Company, Limited, Millbank, London, S.W.1.

Agents for Canada

As the result of a recent tour of Canada by Mr. J. G. Gershon, sales director of **Rocol Ltd.,** manufacturers of specialized molybdenized and other lubricants, the following agents have been appointed:—For British Columbia, International Agencies and Machinery Co., Ltd., of Vancouver, B.C., for the rest of Canada, W. R. Watkins Co., Ltd., of Toronto.

Enquiry from Yugoslavia

An enquiry has reached the British Embassy at Belgrade from "Komercbiro," Kosmajska (P.O. Box 901), Belgrade, who wish to receive specifications and quotations for the supply of tin and zinc sheet for use in the Yugoslav shipyards. The inquiring firm was established in 1953 as manufacturers' agents and represents a large number of foreign companies.

Manufacturers interested in this enquiry are advised to write direct to the firm concerned. The Board of Trade emphasizes that "Komercbiro" is an agency enterprise and therefore not authorized under the Yugoslavia regulations to import on their own account. This must be effected through one of the regular Import enterprises. (Ref. ESB/19424/58.)

Aluminium Plant for Angola

Recent news from Paris is to the effect that the French aluminium producer Pechiney has reached an agreement with Aluminio Portugues (Angola) SARL, to construct a 50,000 tons per year aluminium plant in the Portuguese African territory of Angola. Pechiney has announced that it would act as consulting engineers and that it had acquired a capital participation in the new project. French firms would supply the necessary equipment for which medium-term credits would be granted.

The plant would start producing at a rate of 25,000 tons a year. A hydro-electric power station at Cambambe, sited on the middle Cuanza, would produce an estimated 1,420 million kilowatt hours a year of which the aluminium plant would absorb 920 million when operating at capacity.

Argentine Imports

New regulations on the part of the Argentine Government are said to be part of a plan to change a large number of imports from the official to the free rate. It is said that a number of articles now entirely on the free exchange rate list are to be subject to a 100 per cent customs bond which is refundable after six months. These articles include copper cables, zinc, and carbon steel.

Nickel Alloys Exhibition

A series of four-day exhibitions devoted to the practical uses of nickel and its alloys are to be held in Newcastle, Leeds and Belfast, during September and October, by **Henry Wiggin and Co. Ltd.** The first will be at the Royal Station Hotel, Newcastle upon Tyne, from September 23-26; the second at the Metropole, Leeds, from October 14-17, and the final one in this series will be from October 28-31 at the Grand Central Hotel, Belfast.

Running concurrently with each exhibition will be a series of lectures and film shows demonstrating the practical uses of Wiggin alloys in high temperature work, and in chemical and electrical engineering, and others will feature welding techniques.

The exhibition will include comprehensive displays illustrating the various properties of the Wiggin alloys—corrosion resistance, high temperature properties, electrical resistance, and special physical properties—and these will be backed by over 300 examples of actual components, each using one or more of the alloys, to show how all industries take practical advantage of the special characteristics.

Tickets for each exhibition are available from the local area office of Henry Wiggin and Co. Ltd., or direct from the head office at Wiggin Street, Birmingham, 16.

Sole Concessionaires

It is understood that Laboratoire Pacaut and Veyron, of France, have made suitable arrangements for **Combustion Chemicals Ltd.,** of London, to be sole concessionaires in the U.K., Commonwealth, Scandinavia and the Americas for their fuel oil and diesel fuel improvers, "Desulfurol" and "Dieselfur." These products have been proved and established in France over many years, and are in constant use by many of the major industrial concerns in that country.

"Desulfurol" is also well known in the U.K., where extremely good results in improved combustion, and reduction in sulphur corrosion, together with elimination of the soot and smut emission problem, have been achieved in extensive trials.

Telescopic aluminium stairway for use at airports

Aluminium Aircraft Steps

A telescopic aluminium stairway, mounted on a tubular steel chassis, provides a new type of aircraft passenger gangway, which, easily transportable and readily adjustable in height to suit most aircraft, will facilitate embarking and disembarking. The stairway, manufactured by Spurling Motor Bodies Ltd., comprises two main stair assemblies. The height range is from 6 ft. 3 in., when the upper assembly is retracted, to 10 ft. 7½ in. when it is fully extended; adjustment is made by means of a direct action, manually operated screw gear, which is preferred to a hydraulic system because of its lower maintenance costs. The hand-operated system calls for moving parts of low weight, and this was a major reason for the choice of aluminium alloy sheet and sections for the construction of the two stair assemblies.

The panelling is of painted Noral 3S sheet on the outside, and on the inside, where frequent scratches and knocks during use might mar the appearance of paintwork and make periodic repainting necessary, unpainted patterned sheet of attractive appearance is used. The natural durability of aluminium renders painting, as a protective measure, unnecessary, although, as with the exterior panelling of this stairway, it is sometimes desirable to achieve a particular coloured decorative effect. The steps themselves have risers of the same patterned sheet and treads of Noral plain sheet. Plastics-filled wearing strips and edge nosing, and reinforcing sections, all of Noral alloys supplied by **Northern Aluminium Limited** are fitted to each tread. The risers are 7½ in. high and the treads 11½ in. deep. The tubular handrails, which are fitted to both sides of the stairway, are of bright anodized Noral alloy.

The stairway is built into two 7 in. channels which ride on two fixed 6 in. channels attached to the chassis. These channels, which, like all the other sections used are of Noral B51S alloy, not only have a high strength/weight ratio, but are produced by the extrusion process to close tolerances; their dimensional accuracy and good finish makes it possible to obtain the desired sliding fit between the channels, in the "as supplied" condition.

The ease of operation, and adaptability of this aluminium stairway to suit successive arrivals and departures of different types of aircraft, is matched by the ease of use by passengers; this is aided by an intermediate platform at the top of the lower assembly, which breaks up the long downward slope of the stairs as seen from an aircraft, and so makes for a comfortable and easy descent, particularly when the stairway is fully extended.

New Ferodo Product

A new sintered metal friction material —Ferodo SM7—has just been added to their existing range by **Ferodo Limited.** It is bronze based and designed for dry applications only, where smooth take-up characteristics are required, notably in marine reversing gear boxes. The material is supplied sintered either to metal core or backing plates. Full details and technical data of this new sintered metal clutch facing may be obtained on application to the company.

Marketing Arrangement

Negotiations have recently been completed by **Startrite Machine Tool Co. Ltd.** with "Meba" Maschoenenbau, of Esslingen, for a marketing arrangement for the sale of "Startrite" vertical bandsawing machines in Germany, and for the distribution of "Meba" horizontal cut-off bandsaws in the United Kingdom.

All equipment will be marketed under the common name of "Startrite-Meba," and certain parts and extras will be manufactured under licence by both companies to reduce freight and duty charges.

New Premises

It has been announced by **E. H. Jones (Machine Tools) Ltd.,** of Hove, Sussex, that a new office and showroom is shortly to be opened at Wilson Place, Nerston Industrial Estate, East Kilbride, Scotland. This office will be under the direction of Mr. G. Cranston, to whom reference is made on page 141 of this journal.

Patent Office Library

A second edition of the list of its current periodical holdings has just been issued by the Patent Office Library in London, which has a world-wide collection of scientific and technical periodicals, as well as patent specifications and journals.

The list covers 258 pages, and gives the titles, first dates and locations in the library of over 6,000 current periodicals. It can be obtained, price 12s. 6d., from H.M. Stationery Office, York House, Kingsway, London, W.C.2, and at the Sales Branch Counter of the Patent Office, or through any bookseller.

Trade with Australia

In connection with the new import licensing period, August-November 1958, the Australian Minister for Trade has announced certain changes in the treatment accorded to certain goods.

More goods have been added to those which are exempt from import licensing, and these include the following items:— cobalt, magnesium, vanadium and arsenic metals, chrome and calcium silicide, molybdenum and chromium metals.

Canadian Metals for India

Recent news from Ottawa states that India is to import between 9·5 million and 10 million dollars' worth of Canadian copper, aluminium and nickel this year under the Colombo Plan. Such imports last year amounted to 11 million dollars, Mr. R. W. Rosenthal, administrator of Canada's Colombo Plan assistance and other similar help abroad, told the External Affairs Committee of the House of Commons. Mr. Rosenthal said that India's fiscal problems had made it difficult for her to contract for her capital projects. Equipment required for her second five-year plan, now under way, was already covered by loans and credits.

"The Government of India has thus found it essential to keep its present industries supplied with raw materials, and this was reflected in our programme for India in 1957-58, where high priority was given to the supply of copper, aluminium and nickel," he went on. "Although the Indian capital aid programme for this year, 1958-59, has not yet been negotiated, our information is that commodities and raw materials will again be urgently requested." Mr. Rosenthal added that present commitments, to the close of the navigation season in November, were for shipments of the three metals totalling between 9·5 million and 10 million dollars. The 11 million dollars' worth of such shipments last year amounted to just less than one-half of India's total 23 million dollars Colombo Plan aid from Canada, he said.

Trade with Germany

Two senior representatives of **Simmonds Aerocessories Ltd.** are visiting Frankfurt this month. Mr. R. Goodburn will be discussing with his company's agents and customers the sales and promotion of Surform tools, for which he is export sales manager. Mr. W. H. Dothie, who accompanies Mr. Goodburn, is an assistant export sales manager for other products of the company, which is a member of the Firth Cleveland group.

Honeywell Head Office

With an "At Home" to families and a key-turning ceremony attended by staff and local officials, **Honeywell Controls Limited** recently celebrated the official opening of its new head office building in Greenford, Middlesex. The building, a photograph of which is given on opposite page, was declared open by Mr. Harold Sweatt, chairman of the Honeywell organization. He had come over from

New headquarters at Greenford for Honeywell Controls Limited

Minneapolis, home of the company's American associates, for the ceremony.

In his address to the staff of the company, Mr. Sweatt said: "Although you started making instruments only eight years ago, you are already among the largest manufacturing companies in the United Kingdom. Your factory now covers 166,000 ft^2, and you have opened ten fully-equipped branch offices to create a nation-wide marketing organization."

Canadian Statistics

Production of copper, gold, lead, silver and zinc in Canada was larger in April this year than last, but output of asbestos, iron ore and nickel was smaller, according to the Dominion Bureau of Statistic's monthly report on leading minerals. Minerals with larger output in April (April 1957 in brackets): copper, 32,598 tons (28,015); gold, 382,433 fine ounces (369,251); lead, 15,644 tons (14,275); silver, 2,558,958 fine ounces (2,225,638); and zinc, 34,724 tons (33,306). Minerals with smaller output: asbestos, 83,477 tons (107,066); iron ore, 232,613 tons (308,070); nickel, 15,009 tons (15,347).

Metals in Burma

According to recent reports from Rangoon, the tin and wolfram industries in Burma have been severely hit by the current slump in world mineral prices. Several small mines had to close down, while larger operators had continued to work at heavy loss, the correspondent said. The Mineowners' Association had asked the Government to take firm measures to help laid-off workers and to exempt owners from land taxes, he said. Meanwhile, in Rangoon, mining circles reported that Mawchi Mines, formerly one of the largest tin and wolfram mines in Burma, might have to retrench workers due to further activities by insurgents in the mine area and the difficulty in obtaining skilled underground labour.

An executive of Mawchi Mines is reported to have said that the company had informed its shareholders last month of changes which had to be made. He said that, because of a raid by insurgents very early in July, most of the mine stores and underground mining equipment had been destroyed. This fact, coupled with the low metal prices, especially for wolfram, had made changes inevitable. Many European miners had been given notice, and a substantial proportion of the Asian employees had been paid off. It was, however, now thought possible that modified operations might be resumed, possibly with a larger contingent of staff than had previously been anticipated.

Birmingham Exhibits

Some new items have been included among the exhibits at the **Birmingham Exchange and Engineering Centre** recently. A completely new display unit has been installed by **Rozalex Ltd.**, featuring the industrial applications of barrier creams as a safeguard against dermatitis. Typical examples are shown of the various types and applications, such as No. 1 for dry working conditions, No. 2 for general purposes, No. 8 for use in wet work such as machine coolants, and No. 4, which is a lanolin skin cream to relieve irritation from cracked or chafed hands. Also shown is the patented dispenser produced by the company for factory or workshop, which ensures the most economic uses of these creams.

Installed on their exhibit by **Roto-Finish Ltd.** is an example of their "Midget" model D.W. 16/16/2, which is a handy size edition of the very wide range of their barrelling machines available, and illustrates in every way the advantages of the larger machines. This particular example has a barrel of only 16 in. by 16 in., with a capacity of $1\frac{1}{4}$ ft^3 and a work load of 40 lb. max.

In their new display at the Centre, the **Glacier Metal Company Ltd.** show many examples from their range of production. These include micro-whitemetal linings of the thin wall type for the optimum in whitemetal fatigue strength, and as supplied for current use to the major motor manufacturing concerns in Britain. P.C.L. 100, also shown, is a special type of bearing, which has a lead-bronze lining with a lead base overlay and is particularly suitable for heavy duty in high performance car engines or high-speed diesels. Standard bronze and wrapped bearings for normal engineering requirements are also included, and have a wide range of application. Copper-lead on steel and aluminium-tin on steel are high load bearings also shown, and a special feature is made of the new P.T.F.E. lined "dry" bearings. In addition to bearings, the display includes standard bronze bars, die-castings and bronze castings, and also their centrifugal by-pass filter, which provides continuous efficiency in centrifugal separation of dirt from lubricating oil.

Men and Metals

It has been announced by The Institution of Mining and Metallurgy that the President-Elect of the institution for the forthcoming year is **Dr. J. H. Watson,** Ph.D., B.Sc., who is chemist and assayer of the Royal Mint. He has been a member of the Council of the Institution since 1949, serving as a Vice-President from 1954 to 1957. Dr. Watson joined the institution as a student in 1919 becoming an associate member in 1924 and a full member in 1941.

News from Fawcett Preston and Company Limited, one of the engineering subsidiaries of the Metal Industries Group, is that **Mr. H. H. Saint** has been appointed general sales manager of the company and will be responsible for all home sales. **Mr. E. P. Bridson,** formerly in charge of the company's London office, becomes export sales manager.

Changes in personnel have taken place recently within the organization of E. H. Jones (Machine Tools) Limited, as follows:—**Mr. L. R. Newing** has been appointed outside sales manager for home sales; **Mr. H. M. Lebrecht,** A.M.I.Mech.E., who has been manager of the special machinery sales division for some time, has been appointed inside sales manager; and **Mr. G. Cranston** has been appointed area manager for Scotland.

We are informed that **Mr. H. J. Smith,** managing director of The Industrial Pyrometer Company Ltd., is leaving at the end of this month to visit Canada, where he will stay until September 2, and then will go on to the United States, remaining there until September 24, when he will return to England. Mr. Smith will be visiting the main centres of Montreal, Toronto, Detroit, Chicago, St. Louis, Cincinnati, Cleveland, Pittsburgh, Philadelphia, and New York, and will also attend the Instrument-Automation Conference and Exhibition in Philadelphia. The purpose of Mr. Smith's visit is to explore the market from the point of view of exports and arrangements for exploiting any suitable American equipment on the British market.

Metal Market News

GENERALLY the first week in August is a time of quiet trading with business somewhat restricted on account of the holidays, but this year has proved exceptional, and we saw four days of moving prices, at any rate in copper, immediately following the Bank Holiday. The background continued to be optimistic, for not only did Wall Street continue its upward movement day by day, with just one reaction which was shortlived, but conditions on the Stock Exchange were decidedly cheerful. On the whole, the tendency of the non-ferrous markets was, if anything, rather downwards, and copper, at any rate, lost some ground, but the loss was not serious and the close was fairly firm in spite of the fact that on Thursday last week it became known here that the custom smelters had dropped their price by ½ cent to 26½ cents, thus returning to the level at which they stood at the end of July. Stocks of copper at the beginning of the week were announced as being 1,075 tons down at 12,457 tons, and the contango remained small all the week. Perhaps the outstanding event of the week was the announcement immediately after the holidays that Kennecott had decided upon a return to a five-day week, this meaning that their annual production would be increased by about 60,000 tons. Not unnaturally, this upset confidence, but it was not until news of the customs smelters' ½ cent reduction came through that the market broke seriously, the settlement price falling to £203 10s. 0d., or £5 below the previous day. Three months was quoted at £204, but this proved to be the bottom of the decline, and on Friday afternoon the close was £207 cash and £207 15s. 0d. forward. The turnover was 7,775 tons, and on balance cash lost £3 on the week and three months £2 10s. 0d. Opinions on the trend of the market are varied and sometimes contradictory but sentiment is certainly more optimistic than it was, and there is a tendency to view everything through rose-tinted spectacles. The prospects for East-West trade is a case in point. To what extent favourable factors have already been discounted in the present price level is a moot point.

The announcement by Kennecott that they intend to step up output from September certainly came as a surprise and something of a shock to the market. Current comment was that it seemed rather absurd to be stockpiling copper because of the top-heavy position of stocks in the U.S.A. while the largest American domestic producer has adopted a programme of output expansion. Another point is, what effect will this decision have upon other producers? Is it not possible that they will be encouraged to follow this example and begin once again to build up in activity at the mines? Cutting back production has, understandably enough, never been popular with mining companies, and there can be little doubt that any moderately good excuse to expand would be grasped at eagerly. As to the price level, voices have always been raised to affirm that even at £160 many companies make profits, and these same people are insistent that copper is high enough at £200. Competition certainly is not lessening, for both plastics and light alloys are forging ahead.

There is not much to be said about the other metals, which were dull and rather featureless. In tin, the turnover was only about 370 tons, and prices were virtually unchanged on balance for both cash and forward. Very little, if any, support by the Tin Council was necessary, for there were buyers of cash at a price above the support level. The close was £731 10s. 0d. cash and £734 10s. 0d. three months. Zinc was fairly active and some 4,700 tons changed hands, August losing 5s. on balance and November 2s. 6d., at £64 15s. 0d. and £65 7s. 6d. respectively. In lead, the turnover was around 2,600 tons, prompt being 2s. 6d. up and forward 2s. 6d. down, the closing quotations being £72 5s. 0d. August and £72 2s. 6d. November.

Birmingham

Latest figures of unemployment in the Midlands reveal an increase of nearly 800 in a month. Nevertheless, the Midland figure is only 1·5 per cent, compared with a national average of 1·9 per cent. This change for the worse is due in large measure to a drop in activity in the engineering and metal-working industries. It is estimated that the engineering trades generally are operating at about 20 per cent below capacity. Order books are shorter, and the amount of overtime now being worked in the area is probably smaller than it has been for many years. Motor car manufacturers are still optimistic, and a representative spokesman said recently that the industry expected to break more records in production and export in the coming months.

Iron and steel activity is back to normal after the holidays. A good demand continues from the heavy electrical engineers, the motor trade, shipbuilding and rolling stock. The supply position is much easier than it was earlier in the year. Even the tension in heavy steel plates has been relieved, and delivery can be obtained in much more reasonable time. New orders for constructional steel are more difficult to obtain, but substantial tonnages of heavy joists, sections and angles are still being delivered to sites against old contracts. The re-rolling steel works are operating on a short-time basis. Foundries could take on much more work if it was available, and supplies of pig iron are plentiful.

United States

The Rules Committee of the House of Representatives is to hold a hearing on the Bill to pay subsidies to United States producers on their commercial sales of minerals. Commenting on this announcement by a Committee spokesman, Committee officials pointed out that it was still not certain that the Committee would even approve sending the measure to the House floor, as some members opposed the whole idea of subsidies for metal miners. Committee officials said the hearing would be an appeal by Congressmen to establish how the Bill would be considered on the House floor and the time allowed for debate.

The House Interior Committee approved the Bill towards the end of July. It would provide the same subsidy payments to producers as the Senate-approved measure on lead, zinc, tungsten, and acid-grade fluorspar sales. It would also authorize the Secretary of the Interior to purchase 150,000 tons of copper for the National Stockpile. The Senate measure would allow the Secretary of the Interior to borrow directly from the Treasury the necessary funds to pay the costs of the five-year subsidy programme. The House Bill would require a Congressional appropriation from Congress each year to pay the subsidies.

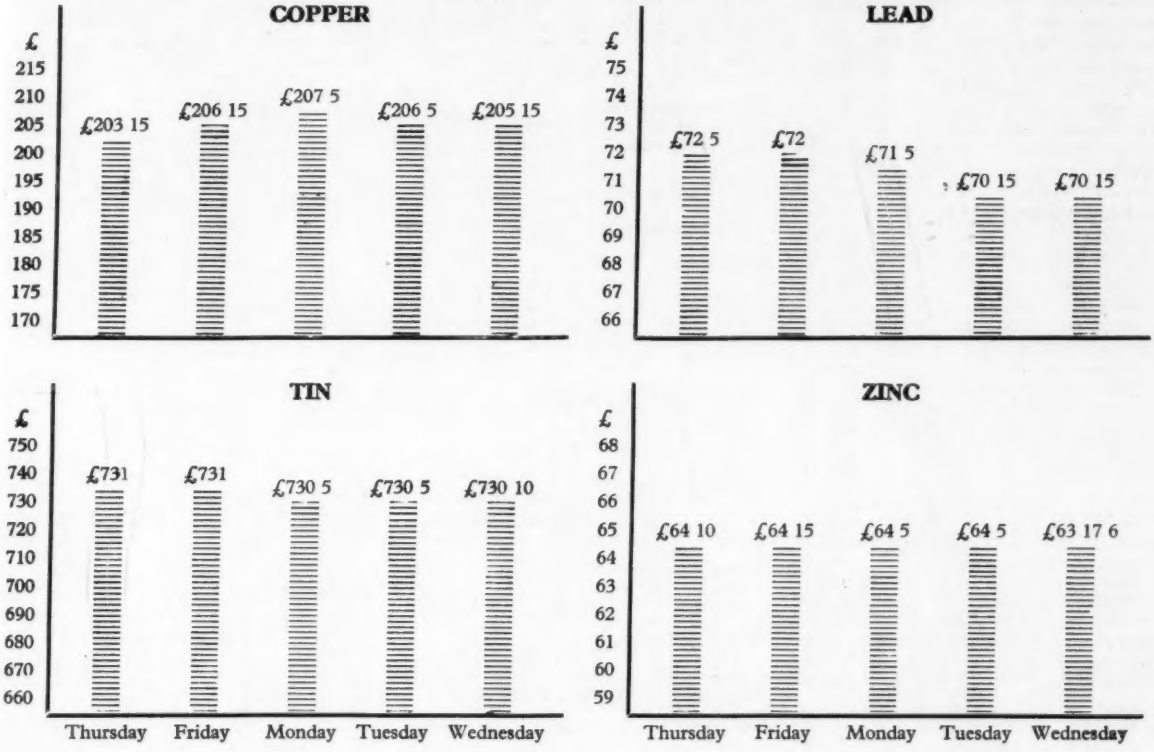
Thus, even if the House were allowed to consider the Bill, pass it and send it to conference with the Senate, Congress would still have to pass a separate appropriation measure unless the Senate payment provisions were adopted. This, officials said, would be difficult in the short time left before Congress adjourned. However, the adjournment date was still in doubt.

The officials added that western mining states Congressmen—in this Congressional election year—did not want to return empty-handed to their constituents, and undoubtedly would plead eloquently to the Rules Committee to allow House consideration of the Bill. They also could be counted on to do everything possible to speed a House-Senate compromise Bill if the measure got as far as that.

During the past week, custom smelters reported fair sales of copper. Producers said that sales continued good, and one leading seller stated that tubing mills were currently the best buyers of copper, relatively outpacing wire mills. Copper futures were modestly higher in substantial volume. Lead and zinc were quiet, with lead sales for the week totalling 4,355 tons. Tin was quiet, with a soft undertone.

METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 7 August 1958 to Wednesday 13 August 1958



OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton		Canada c/lb ≏ £/ton		France fr/kg ≏ £/ton		Italy lire/kg ≏ £/ton		Switzerland fr/kg ≏ £/ton		United States c/lb ≏ £/ton	
Aluminium			22.50	185 17 6	210	182 15	375	217 10			26.80	214 10
Antimony 99.0					195	169 12 6	420	243 12 6			29.00	232 0
Cadmium					1,500	1,305 0					155.00	1,240 0
Copper												
Crude												
Wire bars 99.9							415	240 15				
Electrolytic	29.00	212 0	24.75	204 10	260	226 5			2.45	192 12 6	26.50	212 0
Lead			10.75	88 15	110	95 15	179	103 17 6	.87	77 15	10.00	80 0
Magnesium												
Nickel			70.00	578 5	1,205	1,048 7 6	1,300	754 0	7.80	652 5	74.00	592 0
Tin	102.50	749 5			894	777 15	1,400	812 0	8.60	719 2 6	95.37	763 0
Zinc												
Prime western			10.00	82 12 6							10.00	80 0
High grade 99.95			10.60	87 10 0								
High grade 99.99			11.00	90 5								
Thermic					107.12	93 2 6						
Electrolytic					115.12	100 2 6	159	92 5	.82	68 10	11.25	99 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 12 noon 13/8/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		10	0
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite	per unit		—	
Copper H.C. Electro	ton	205	15	0
Fire Refined 99·70%	„	204	0	0
Fire Refined 99·50%	„	203	0	0
Copper Sulphate	„	70	0	0
Germanium	grm.		—	
Gold	oz.	12	10	4
Indium	„		10	0
Iridium	„	20	0	0
Lanthanum	grm.		15	0
Lead English	ton	70	15	0
Magnesium Ingots	lb.		2	5½
Notched Bar	„		2	10½
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	290	0	0
Mercury	flask	79	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	5	15	0
Platinum	„	23	5	0
Rhodium	„	40	0	0
Ruthenium	„	16	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	3
Tellurium	lb.		15	0
Tin	ton	730	10	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	64	4	4½
Dust 95/97%	„	104	0	0
Dust 98/99%	„	110	0	0
Granulated 99+%	„	89	4	4½
Granulated 99·99+%	„	101	15	0

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0

		£	s.	d.
†**Aluminium Alloy (Secondary)**				
B.S. 1490 L.M.1	ton	145	10	0
B.S. 1490 L.M.2	„	155	10	0
B.S. 1490 L.M.4	„	173	10	0
B.S. 1490 L.M.6	„	190	0	0

†Average selling prices for mid July

***Aluminium Bronze**				
BSS 1400 AB.1	ton	213	0	0
BSS 1400 AB.2	„	230	0	0
***Brass**				
BSS 1400-B3 65/35	„	141	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„		—	
***Gunmetal**				
R.C.H. 3/4% ton	ton		—	
(85/5/5/5)	„	172	0	0
(86/7/5/2)	„	183	0	0
(88/10/2/1)	„	229	0	0
(88/10/2/½)	„	245	0	0
Manganese Bronze				
BSS 1400 HTB1	„	175	0	0
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„		—	
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
2B8 guaranteed A.I.D. released	„	255	0	0
Phosphor Copper				
10%	„	232	0	0
15%	„	239	0	0
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	344	3	0
Grade D Plumbers	„	278	3	0
Grade M	„	377	3	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
Mazak III	ton	95	0	0
Mazak V	„	99	0	0
Kayem	„	105	0	0
Kayem II	„	111	0	0
Sodium-Zinc	lb.		2	5

*Average prices for the last week-end.

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium			£	s.	d.
Sheet 10	S.W.G.	lb.		2	8
Sheet 18	S.W.G.	„		2	10
Sheet 24	S.W.G.	„		3	1
Strip 10	S.W.G.	„		2	8
Strip 18	S.W.G.	„		2	9
Strip 24	S.W.G.	„		2	10½
Circles 22	S.W.G.	„		3	2
Circles 18	S.W.G.	„		3	1
Circles 12	S.W.G.	„		3	0
Plate as rolled		„		2	7½
Sections		„		3	1½
Wire 10 S.W.G.		„		2	11
Tubes 1 in. o.d. 16 S.W.G.		„		4	0

Aluminium Alloys		£	s.	d.
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	0½
Sheet 18 S.W.G.	„		3	3
Sheet 24 S.W.G.	„		3	10½
Strip 10 S.W.G.	„		3	0½
Strip 18 S.W.G.	„		3	2
Strip 24 S.W.G.	„		3	10
BS1477 HP30M. Plate as rolled	„		2	10½
BS1470. HC15WP.				
Sheet 10 S.W.G.	lb.		3	6½
Sheet 18 S.W.G.	„		4	0½
Sheet 24 S.W.G.	„		4	10½
Strip 10 S.W.G.	„		3	9½
Strip 18 S.W.G.	„		4	0½
Strip 24 S.W.G.	„		4	8
BS1477. HPC15WP. Plate heat treated	„		3	5½
BS1475. HG10W. Wire 10 S.W.G.	„		3	9½
BS1471. HT10WP. Tubes 1 in. o.d. 16 S.W.G.	„		4	11
BS1476. HE10WP. Sections	„		3	1
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		1	7¾
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	226	10	0
Extruded Bar	lb.		1	10⅛
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	166	0	0
Condenser Plate (Naval Brass)	„	177	0	0
Wire	lb.		2	5½
Copper Tubes	lb.		2	0½
Sheet	ton	235	15	0
Strip	„	235	15	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	257	5	0
Cupro Nickel Tubes 70/30	lb.		3	4⅜
Lead Pipes (London)	ton	113	15	0
Sheets (London)	„	111	10	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7%	„		3	5½
Wire 10%	„		3	11¾
Phosphor Bronze Wire	„		3	8⅞
Titanium (1,000 lb. lots)				
Billet over 4″ dia.-18″ dia.	lb.	63/-		64/-
Rod 4″ dia. - ·250″ dia.	„	75/-		112/-
Wire under ·250″ diam. - ·036″ diam.	„	146/-		222/-
Sheet 8′ × 2′ × ·250″-·010″ thick	„	88/-		157/-
Strip ·048″-·003″ thick	„	100/-		350/-
Tube (representative gauge)	„			300/-
Extrusions	„			120/-
Zinc Sheets, English destinations	ton	98	5	0
Strip	„		nom.	

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 12/8/58.

	£
Aluminium	
New Cuttings	134
Old Rolled	110
Segregated Turnings	90
Brass	
Cuttings	126
Rod Ends	124
Heavy Yellow	108
Light	103
Rolled	119
Collected Scrap	104
Turnings	117
Copper	
Wire	175
Firebox, cut up	168
Heavy	166
Light	161
Cuttings	175
Turnings	158
Braziery	138
Gunmetal	
Gear Wheels	166
Admiralty	166
Commercial	139
Turnings	134
Lead	
Scrap	63
Nickel	
Cuttings	—
Anodes	450
Phosphor Bronze	
Scrap	139
Turnings	134
Zinc	
Remelted	55
Cuttings	42
Old Zinc	30

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£178.7.6)	205
Heavy copper	(£174.0.0)	200
Light copper	(£148.0.0)	170
Heavy brass	(£108.15.0)	125
Light brass	(£82.12.6)	95
Soft lead scrap	(£61.0.0)	70
Zinc scrap	(£34.17.6)	40
Used aluminium unsorted	(£87.0.0)	100
France (francs per kilo):		
Copper	(£208.17.6)	240
Heavy copper	(£208.17.6)	240
Light brass	(£143.10.0)	165
Zinc castings	(£65.5.0)	75
Lead	(£82.12.6)	95
Tin	(£565.10.0)	650
Aluminium	(£117.10.0)	135
Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£191.10.0)	330
Aluminium copper alloy	(£116.0.0)	200
Lead, soft, first quality	(£84.12.6)	146
Lead, battery plates	(£49.17.6)	86
Copper, first grade	(£194.7.6)	335
Copper, second grade	(£179.17.6)	310
Bronze, first quality machinery	(£188.10.0)	325
Bronze, commercial gunmetal	(£159.10.0)	275
Brass, heavy	(£130.10.0)	225
Brass, light	(£119.0.0)	205
Brass, bar turnings	(£127.12.6)	220
New zinc sheet clippings	(£55.2.6)	95
Old zinc	(£40.12.6)	70

Financial News

Aluminium Ltd.

Net income of Aluminium Limited during the first six months of 1958, after deducting preferred dividends of subsidiaries is reported at 10,451,000 Canadian dollars, or 35 cents per common share, against 26,548,000 dollars, or 88 cents a share, in the first half of 1957. Sales and operating revenues during the period totalled 207,958,000 dollars, against 233,535,000 dollars in the first half of 1957. Mr. N. V. Davis, President, pointed out that a reduction in aluminium prices at the beginning of the second quarter seemed to have stimulated demand. Sales were 150,000 tons in the second quarter of 1958, compared with 128,000 in the first quarter and 156,000 tons in the second quarter of 1957.

Alfred Herbert Ltd.

An interim dividend of 2 per cent, free of tax, on capital increased to £10,923,750 by a one-for-one free scrip issue, equivalent to the previous 4 per cent on old capital, has been declared.

Guest, Keen and Nettlefolds Ltd.

It is reported that the company has decided to make a scrip issue of three new £1 ordinary shares for every £10 of stock held. It is explained by the directors that this issue does not imply an increase in the total sum to be paid as dividend this year. It is, in fact, proposed to pay an interim dividend of 4 per cent on the larger capital. Last year it was 5 per cent on the old capital.

The Owen Organization

The Owen group is stated to have acquired the business of Mechanair, formerly carried on by Acocks Engineering. Air compressors and installations, welded fabrications, pressure vessels, etc., are among the products of Mechanair, and in future these products will be manufactured at Darlaston.

Hilger and Watts Ltd.

An interim dividend of 5 per cent has been notified by the directors, as against 3 per cent, but they state that this does not imply an increase in the total for the year ending September 30 next.

E. Austin and Sons (London)

Provisional group trading profit is shown at £61,056 (£87,825), with net profit at £7,369. Recommended dividend is 4 per cent.

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Frank Loring and Co. Ltd. (607991), 23 Howard Street, Cardiff. Registered July 15, 1958. To take over the business of a merchant in industrial scrap metal and residues carried on at Cardiff by Frank Loring as "Frank Loring and Co.," etc. Nominal capital, £5,000 in £1 shares. Directors: Frank Loring and John C. Loring.

S. Beer Limited (608085), Trafalgar House, Great Clowes Street, Salford, 7. Registered July 16, 1958. To carry on the business of scrap merchants, etc. Nominal capital, £3,000 in £1 shares. Directors: Solomon Beer, Max Beer, Harry Beer and Alan Beer.

A. Tagliaferri Industrial Furnaces Limited (608770), 79/81 Lombard St., Birmingham. Registered July 28, 1958. To carry on business of engineers, iron masters, smelters, founders, etc. Nominal capital, £6,000 in £1 shares. Directors: Mathieu A. de Bock, Aldo Tagliaferri and David H. Wood.

Fisher Segal Limited (608823), 2 Palace Gardens, Enfield, Middlesex. Registered July 29, 1958. To carry on business of applying decorative and protective coatings by use of painting, induction, deposition, passivation or any like processes to all kinds of metal, alloys, wood, plastics, etc. Nominal capital, £2,000 in £1 shares. Directors: Clive U. Fisher, Jack Segal and Wm. F. Denison.

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ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 12 AUGUST	+RISE —FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	21/3	+3d.	9	10	8 11 6	21/3	17/6	28/3	18/–
400,000	2/–	Anti-Attrition Metal	1/6		4	8½	5 6 9	1/6	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	52/3	+2/3	15	15	5 14 9	52/3	46/6	72/3	47/9
1,590,000	1	Birfield Industries	52/6	+6d.	15	15	5 14 3	57/–	46/3	70/–	48/9
3,196,667	1	Birmid Industries	71/–	—6d.	17½	17½	4 18 9	71/6	55/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	30/–	+9d.	10	8	6 13 3	30/–	23/9	33/–	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/4½		5	5	6 10 0	15/7½	14/7½	16/–	15/–
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/3	+7½d.	6	6	6 19 3	17/3	16/6	19/–	16/6
500,000	1	Bolton (Thos.) & Sons	24/4½	+4½d.	12½	12½	10 5 3	28/9	24/–	30/3	28/9
300,000	1	Ditto Pref. 5%	15/–		5	5	6 13 3	16/–	15/–	16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/–		7	7	7 0 0	19/4½	19/–	22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	50/9	—9d.	12	12	4 14 6	51/6	36/6	72/–	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	18/10½	+1½d.	6	6	6 7 3	19/3	18/4½	21/6	18/–
15,000,000	Stk. (£1)	British Insulated Callender's Cables	43/–	+6d.	12½	12½	5 16 3	45/6	38/9	55/–	40/–
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	38/6xd	+2/–	10	10	5 4 0	38/6	29/–	39/–	29/6
600,000	Stk. (5/–)	Canning (W.) & Co.	20/–	—6d	25+	*2½C	6 5 0	21/–	19/7½	24/6	19/3
60,484	1/–	Carr (Chas.)	1/4½	—1½d.	25	25	12 14 6X	2/3	1/4½	3/6	2/1½
150,000	2/–	Case (Alfred) & Co. Ltd.	4/–	—1½d.	25	25	12 10 0	4/9	4/–	4/6	4/–
555,000	1	Clifford (Chas.) Ltd.	19/–		10	10	10 10 6	19/–	16/–	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/9		6	6	7 12 6	15/10½	15/7½	17/6	16/–
250,000	2/–	Coley Metals	2/9	—1½d.	20	25	14 11 0	4/6	2/6	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	49/6	+2/3	18¾	22½	7 11 6	51/6	41/–	92/6	49/–
1,136,233	1	Davy & United	63/9	+1/9	20	15	6 5 6	63/9	45/9	60/6	42/6
2,750,000	5/–	Delta Metal	19/10½	+6d.	30	*17½	7 11 0	21/4½	17/7½	28/6	19/–
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	33/–	+6d.	12½	15B	7 11 6	34/–	22/9	38/6	25/–
750,000	1	Evered & Co.	27/9		15Z	15	7 4 0	28/3	26/–	52/9	42/–
18,000,000	Stk. (£1)	General Electric Co.	35/3xd	+3d.	10	12½	5 13 6	38/7½	29/6	59/–	38/–
1,500,000	Stk. (10/–)	General Refractories Ltd.	33/–	+1/9	20	17½	6 13 0	34/7½	27/3	37/–	26/9
401,240	1	Gibbons (Dudley) Ltd.	63/–		15	15	4 15 3	66/3	63/–	71/–	53/–
750,000	5/–	Glacier Metal Co. Ltd.	5/6		11½	11½	10 9 3	6/6	5/6	8/1½	5/10½
1,750,000	5/–	Glynwed Tubes	14/4½	+4½d.	20	20	6 19 3	14/4½	12/10½	18/–	12/6
5,421,049	10/–	Goodlass Wall & Lead Industries ...	24/3		13‖	18Z	5 7 0	24/6	19/3	37/3	28/9
342,195	1	Greenwood & Batley	48/3		20	17½	8 5 9	49/3	45/–	50/–	46/–
396,000	5/–	Harrison (B'ham) Ord.	13/3		*15	*15	5 13 3	13/6	11/6	16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	19/–		7	7	7 7 3	19/–	18/9	22/3	18/7½
1,075,167	5/–	Heenan Group	7/9		10	20‡	6 9 0	7/9	6/9	10/4½	6/9
216,531,615	Stk. (£1)	Imperial Chemical Industries ...	32/3	+2/4½	12Z	10	4 17 3	32/3	27/7½	46/6	36/3
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5%	16/6	+6d.	5	5	6 1 3	17/1½	16/–	18/6	15/6
14,584,025	**	International Nickel	154¾	+3¾	$3.75	$3.75	4 7 0	154¾	132¾	222	130
430,000	5/–	Jenks (E. P.), Ltd.	7/6xd	+1½d.	27½φ	27½	9 3 3	8/3	6/9	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/9	+6d.	5	5	5 19 6	16/9	15/–	17/–	14/6
3,987,435	1	Ditto Ord.	38/–	+1/–	10	10	5 5 3	45/3	36/6	58/9	40/–
600,000	10/–	Keith, Blackman	20/–		17½	15	8 15 C	20/–	15/–	21/9	15/–
160,000	4/–	London Aluminium	4/3		10	10	9 8 3	4/4½	3/–	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord. ...	46/–	+9d.	12½	12½	5 8 9	46/–	39/9	54/6	41/–
400,000	1	Ditto Pref.	23/3		7½	7½	6 9 0	23/3	22/3	25/3	21/9
765,012	1	McKechnie Brothers Ord.	34/3		15	15	8 15 0	35/–	32/–	48/9	37/6
1,530,024	1	Ditto A Ord.	33/–		15	15	9 1 9	33/–	30/–	47/6	36/–
1,108,268	5/–	Manganese Bronze & Brass	10/3	—3d.	20	27½‡	9 15 0	10/9	8/9	21/10½	7/6
50,628	6/–	Ditto (7½% N.C Pref.)	5/9		7½	7½	7 16 6	6/3	5/9	6/6	5/–
13,098,855	Stk. (£1)	Metal Box	53/6		11	11	4 2 3	54/3	41/9	59/–	40/3
415,760	Stk. (2/–)	Metal Traders	7/6	—1½d.	50	50	13 6 9	7/7½	6/3	8/–	6/3
160,000	1	Mint (The) Birmingham	20/1½		10	10	9 18 9	22/9	19/–	25/–	21/6
80,000	5	Ditto Pref. 6%	79/6		6	6	7 11 0	83/6	79/6	90/6	83/6
3,705,670	Stk. (£1)	Morgan Crucible A	38/6	+3d.	10	10	5 4 0	40/–	34/–	54/–	35/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/3	+3d.	5½	5½	6 7 6	17/3	17/–	19/3	16/–
2,200,000	Stk. (£1)	Murex	47/9xd	—7½d.	17½	20	7 6 9	58/9	47/9	79/9	57/–
468,000	5/–	Ratcliffs (Great Bridge)	8/6		10	10	5 17 9	8/7½	6/10½	8/–	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	25/6		20	27½D	7 16 9	27/–	24/6	41/–	24/9
1,365,000	Stk. (5/–)	Serck	14/10½	+1½d.	17½Z	15	3 18 6	14/10½	11/–	18/10½	11/6
600,400	Stk. (£1)	Stone (J.) & Co. (Holdings)	59/3	+3/–	18	16	6 1 6	59/3	43/9	57/6	43/9
600,000	1	Ditto Cum. Pref. 6½%	24/3	+1/3	6½	6½	5 7 3	24/3	19/6	21/9	18/9
14,494,862	Stk. (£1)	Tube Investments Ord.	56/–	+1/–	15	15	5 7 3	56/–	48/4½	70/9	50/6
41,000,000	Stk. (£1)	Vickers	33/–	+3d.	10	10	6 1 3	33/–	28/9	46/–	29/–
750,000	Stk. (£1)	Ditto Pref. 5%	14/9xd		5	5	6 15 6	15/6	14/9	18/–	14/–
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	21/3xd	+4½d.	*5	*5	7 6 3A	23/–	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	78/–	—3d.	20	15	5 2 6	79/–	70/9	83/–	64/–
2,666,034	Stk. (£1)	Westinghouse Brake	38/–	+6d.	10	18P	5 6 9	40/–	32/6	85/–	29/1½
225,000	2/–	Wolverhampton Die-Casting ...	7/4½	+1½d.	25	40	6 15 6	8/–	7/1½	10/1½	7/–
591,000	5/–	Wolverhampton Metal	18/3	+1½d.	27½	27½	7 10 9	18/3	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	3/7½		20	17½E	13 15 9	3/9¾	3/3	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	11/6		6	6	10 8 9	11/6	11/3	12/6	11/3
150,000	1/–	Zinc Alloy Rust Proof	3/–	+1½d.	27	40D	9 0 0	3/1½	2/7½	5/–	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting **Shares of no Par Value. ‡ and 100% Capitalized Issue. •The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/– per share for £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. φ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits.